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THE PREDICTION OF SHOPWORK PERFORMANCE IN AN ADULT REHABILITATION PROGRAM: THE KENT SHAKOW INDUSTRIAL FORMBOARD SERIES

Joseph Newman



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THE PREDICTION OF SHOPWORK PERFORMANCE IN AN ADULT REHABILITATION PROGRAM: THE KENT-SHAKOW INDUSTRIAL FORMBOARD SERIES^{1, 2}

JOSEPH NEWMAN

*Director of Education, Municipal Sanatorium
Otisville, New York*

INTRODUCTION

This study was stimulated by the repeated incidental observation that individuals who did well on the Kent-Shakow Industrial Formboard Series (1, 2, 3, 4, 5) were among those who do best in shopwork. It was to secure objective verification of this casual observation that the study was undertaken. Is the K-S Formboard Series of value for predicting performance in shopwork? Is there any relationship between K-S Formboard performance and ability to learn, accuracy, dependability, speed, cooperativeness and constructive thinking in the shop work situation? This study is in a sense exploratory: to discover whether there are trends which would merit further, more refined, and more carefully controlled research with the Kent-Shakow Formboard Series in shopwork.

SUBJECTS AND PROCEDURE

This study covered a period of two years and the results are based on data obtained from 111 male subjects ranging in age from 15 years to 39 years with the median age at 21 years. All the subjects were patients in a tuberculosis sanatorium in New York. At the time they were included in the study, they were all well on the road to recovery and had no adverse medical findings. Such findings would have precluded their participation in the rehabilitation program of the sanatorium.

The rehabilitation program is a regular part of the course of treatment to restore each patient to a normal life. Where return to the occupation before illness is contra-indicated, an attempt is made to redirect the patient into an occupation that is suitable with respect to his medical condition and his background and aptitudes. When occupational change is necessary, the sanatorium period is utilized for observational and exploratory purposes in order to determine possible vocational activities. In the period after discharge from the sana-

¹ The writer wishes to acknowledge his indebtedness to Dr. John Gray Peatman for reading this paper.

² Recommended for publication by Dr. J. G. Peatman.

torium, vocational training is obtained. This training is based on the recommendations of the sanatorium staff.

Before assignment to the rehabilitation program, the patients are generally given an individual battery of tests, which includes a general intelligence test, the Revised Minnesota Paper Form Board Test, the Bennett Test of Mechanical Comprehension, and the K-S Formboard. The purpose of the battery of tests is to secure information as to the aptitudes and training potentialities of each patient.

The K-S Formboard consists of a wooden frame with five differently shaped recesses. There are eight series of blocks to be fitted into these recesses by the subject. Each series grows progressively more difficult and is scored according to time taken to complete. The first series is usually given for practice. However, in this study, it was included in the scoring. The time limits suggested by Teegarden (6) were not followed; rather, each subject was permitted to proceed to the next series as he completed one series until he either completed the test as a whole or could not finish a series. The time required for each completed series was added to give a total score.

None of the subjects had any significant experience in a mechanical or skilled trade. Most of them had backgrounds in general, unskilled work. Generally, in the rehabilitation program of the sanatorium, tests are administered to those who have no suitable occupation or no occupation at all to which they might return after discharge. In other words, those who have occupations to which they might safely return are not tested. Hence, such patients were not included in this study. The subjects of this study were those patients who had been given the K-S Formboard before assignment to the woodworking shop, which they had attended for at least one month.

The purpose of assignment to the woodworking shop is to continue observation of aptitudes and training potentialities; this time in concrete working situations. The shop is well equipped with various woodworking machines and tools. No specific program or course of work is followed nor is there instruction of the formal class-room type. Each individual selects a project for work, and in this, he is free to follow whatever his inclination. He proceeds to plan and carry out the work by himself. Supervision is by a registered occupational therapist and is of an indirect kind. She suggests projects, assists when requested, or when an obvious impasse has been reached. The usual length of time spent in the shop is about three months.

Rating of Shopwork Performance

Shopwork progress was determined by means of the rating scales reproduced in Figure 1.

FIGURE 1
ACTIVITY RATING SCALES

NOTE: Please consider each category by itself and not in relation to the others. Experience has found that more reliable ratings are achieved if specific actions or events are thought of rather than general impressions. Please rate as many categories as you feel qualified to judge. Place an "X" along the line in each category in the position that appears to describe the patient most closely.

(A) *Ability to learn.	(4)*	(3)	(2)	(1)
Ease of learning new methods.	Very Superior	Catches on easily	Ordinary	Needs repeated instructions
(B) Accuracy. Quality of work; freedom from errors.	(1)	(2)	(3)	(4)
	Many errors, careless	Mediocre	Good Quality	High quality Excellent work
(C) Dependability.	(3)	(2)		(1)
Can he be relied on to work without supervision?	Very reliable	Usually reliable	Needs constant supervision	
(D) Speed. Amount of work accomplished.	(1)	(2)	(3)	(4)
	Slow	Moderate	Rapid	High Output
(E) Cooperativeness.	(4)	(3)	(2)	(1)
Ability to work with others.	Exceptionally cooperative	Cooperative	Falls in line	Difficult to handle
(F) Constructive thinking. Ability to grasp a situation and draw conclusions.	(1)	(2)	(3)	(4)
	Needs detailed instructions	Routine worker	Resourceful	Shows originality

*NOTE: The letters and numerals in parentheses were not included in the form. They are inserted here to indicate the method used and to simplify the treatment of the ratings.

The first rating report came one month after assignment and the second, two months later. Usually, discharge came at this point. In some cases, where a longer period of hospitalization was required, there were three, and sometimes more, reports. The rating reports were completed by the occupational therapist. She did not receive any special training in the use of the scales except that which she gained through the discussion of specific types of cases. Such discussion was a continuing procedure.

The question of the validity of the ratings should be considered. It is admitted that there is some possibility that the ratings are not measuring what each category purports to measure. The occupational therapist may have interpreted each to have meant something else than that described. A discussion of the problem, however, indicated that this was not the case. In any event, the occupational therapist had no knowledge of the K-S Formboard performance of any of the subjects rated.

In the treatment of the results of the rating reports, the following procedure was employed. Where there was only one rating report, that was taken to indicate the subject's result. Where there were two rating reports, the lower ratings were taken to represent the categories rated. If there were three or more rating reports, the modal rating was taken to represent the categories rated. The changes in ratings from the first to second reports were analyzed. In 62 ratings, the second rating was higher than the first and in 49 ratings, the second rating was lower than the first. Evidently, the learning effect in the shop was negligible.

Table I shows the number of subjects receiving one rating report, the number receiving two rating reports, etc.

TABLE I
DISTRIBUTION OF SUBJECTS ACCORDING TO
RATING REPORTS
N = 111

Number of Rating Reports	Number of Subjects
At least one	111
At least two	72
At least three	10
At least four	1
Total Number of Rating Reports	194
Average Number of rating reports per subject = $\frac{194}{111} = 1.8$.	

Each category rating was then given a plus (+) value if favorable and a minus (—) value if unfavorable. The determination whether a category rating was favorable or unfavorable was made according to the division of Table II.

TABLE II
POINTS OF DIVISION IN EACH CATEGORY FOR FAVORABLE
AND UNFAVORABLE RATINGS

Category	Favorable	Unfavorable
A	3, 4	1, 2
B	3, 4	1, 2
C	2, 3	1
D	2, 3, 4	1
E	3, 4	1, 2
F	3, 4	1, 2

The point of division in each category seems fairly clear with the exception of categories A and F. In both these categories, the point of division was determined through the usage the occupational therapist made of the various descriptive items. In category A, "Catches on easily" was taken as the normal receptiveness of a subject; anything slower than the average was scored lower on the scale. The same reasoning holds for category D where "moderate" is taken as the normal expectancy.

After the category ratings were transcribed, they were added to give a total plus score and a total minus score for each subject.

At this point, all the subjects were studied in relation to their ratings. Those subjects were eliminated if through case records and personal knowledge there was a suggestion of invalid ratings; these were subjects who had personal differences with the occupational therapist, and whose ratings were probably prejudiced. Ten were so eliminated. Thus the results of the study are based upon a final group of 101 subjects.

The subjects were then ranked in ascending order according to their total time score on the K-S Formboard; the lowest total time score being indicative of the best performance. Those who were unable to complete the K-S Formboard were placed at the end of the ranking according to the number of tests completed and total time required for the completed tests, the highest number of tests completed in the lowest time coming first, and the lowest number of tests completed in the highest total time coming last. The subjects were divided into three groups: highest third; middle third; and lowest third. Each of the first two groups contained 34 subjects and the last group contained 33 subjects.

The range of time scores for each of the groups was as follows:

1. Highest third—8' 26" to 19' 19"
2. Middle third—19' 30" to 36' 9"
3. Lowest third—36' 20" to 28' 31" (four tests completed only).

In order to determine the effect of the number of rating reports a subject received on his placement in any of the three groups, the distribution of results was studied for each group. The data are shown in Table III.

TABLE III
DISTRIBUTION OF SUBJECTS WITHIN EACH K-S SUB-GROUP
ACCORDING TO NUMBER OF RATING REPORTS RECEIVED

K-S Sub-Group	No. of Rating Reports				Total Number of Subjects N = 101
	1	2	3	4	
Highest Third	14	16	4	0	34
Middle Third	12	19	2	1	34
Lowest Third	15	16	2	0	33

It may be apparent that the number of ratings a subject received had little or no relation to his group placement. Table III shows that the distributions are approximately the same for all groups.

RESULTS

The first study of the results was made to determine whether or not the subjects' K-S Formboard results were associated in any general, systematic way with the different ratings of their shopwork. In other words, the results were examined to determine whether there were differences in the shop ratings received by the three K-S subdivisions of the subjects. Table IV shows the distribution of favorable and unfavorable shop ratings for each of the three sub-groups.

Table IV reveals substantial differences between the highest and middle K-S groups for the shop ratings of Categories B, D, and F. The largest differences are for the Accuracy ratings (Category B), where all 34 of the highest K-S group received a favorable rating as compared with only 20 of the middle group, and for the Speed ratings (Category D), where 33 of the highest group had favorable ratings as against 19 in the middle group. The difference between highest and middle groups for Constructive Thinking (Category F) is 27 to 16. The difference for Category A is much less, and there are practically no differences between group ratings for Categories C and E.

TABLE IV
RELATION OF FAVORABLE AND UNFAVORABLE SHOP RATINGS
WITH K-S FORMBOARD RESULTS

Shop Ratings	K-S Formboard Results		
	Lowest Third N = 33	Middle Third N = 34	Highest Third N = 34
A. Ability to learn			
Favorable -----	25	29	34
Unfavorable -----	8	5	0
B. Accuracy			
Favorable -----	18	20	34
Unfavorable -----	15	14	0
C. Dependability			
Favorable -----	31	31	34
Unfavorable -----	2	3	0
D. Speed			
Favorable -----	21	19	33
Unfavorable -----	12	15	1
E. Cooperativeness			
Favorable -----	24	32	33
Unfavorable -----	9	2	1
F. Constructive Thinking			
Favorable -----	13	16	27
Unfavorable -----	20	18	7

Between the middle and lowest K-S groups, there are no large differences except for Category E in which 32 of the middle group received a favorable rating and only 24 of the lowest group received a favorable rating. Except for Category E, then, the greatest differences are between the highest K-S group and the combined middle and lowest K-S groups (there being little difference between these two latter groups).

The Categories in which there are the largest differences, viz., B—Accuracy, D—Speed, F—Constructive Thinking, seem to lend themselves most readily to objective and consistent rating. It is relatively easy to judge a total product as to accuracy, to judge whether a person is slow, and to determine whether a person needs a lot of help or can go along progressively on his own.

From these results, we see that the lowest time scores on the K-S Formboard serve fairly well to differentiate performance in shopwork with respect to accuracy, speed, and constructive thinking, in that order. K-S scores will less clearly differentiate the ability to learn in shop work and the ability to work with others or cooperativeness; they do not show dependability or ability to work without supervision.

The next point of investigation consisted of an analysis of the three K-S groupings of subjects with respect to the total number of favorable and unfavorable ratings received. The results are shown in Table V.

TABLE V
RELATION OF THE RATINGS RECEIVED TO K-S FORMBOARD PERFORMANCE

Number of Favorable or Unfavorable Ratings in the Six Shop work Categories.	K-S Formboard Results		
	Lowest Third	Middle Third	Highest Third
Six Favorable	9	11	25
Five Favorable; One Unfavorable	6	8	9
Four Favorable; Two Unfavorable	2	5	0
Three Favorable; Three Unfavorable	10	4	0
Two Favorable; Four Unfavorable	4	5	0
One Favorable; Five Unfavorable	2	1	0
Six Unfavorable	0	0	0
Totals	33	34	34

Again marked differences are found between those in the highest third and in the middle and lowest thirds of the K-S groups. All 34 subjects in the highest third had at least five favorable ratings. Of those in the middle group, nineteen were so classified, and of those in the lowest group, fifteen. It will be observed that for the two lower thirds the distribution of favorable and unfavorable ratings is about the same.

Since the highest time score required by subjects in the upper third was 19' 19", it may be concluded that a time score of 19' 19" or less on the K-S Formboard is indicative of favorable performance in shopwork. This score limit is based on the lower limit of the highest third, being the total time required for all eight tests (the time limits for each third are shown on page 6). However, inspection of the distribution of the K-S results shows that nine of the eleven subjects in the middle group who received six favorable ratings had a total K-S time score of 24' 49" or less. Thus 34 of the 45 subjects who had six favorable ratings received a K-S score of 24' 49" or less. The distribution of the ratings beyond this point show great variation. Roughly, therefore, a total time score of 25 minutes may be set as a maximum from which favorable shop performance may be expected. However, a greater time score does not preclude good shop performance.

Using the cross-tabulated data in Table VI, the tetrachoric correlation between the K-S Formboard total time score and the criterion

of six favorable ratings is .75, as calculated from Thurstone's (7) computing diagrams.

TABLE VI
CROSS-TABULATION OF K-S FORMBOARD TOTAL TIME
SCORES AND SHOPWORK RATINGS

K-S Total Time Scores	Shopwork Ratings			
		Less than 6+'s	6+'s	Totals
		(-)	(+)	
25' or less	(+)	13	34	47
more than 25'	(-)	43	11	54
Totals		56	45	101

$$r_t = .75$$

From the cross-tabulated data of Table VII, the tetrachoric correlation between the K-S total time score and the criterion of three or more favorable ratings (with at least three in the significant categories, namely, accuracy, speed, and constructive thinking) is .76, as calculated from Thurstone's computing diagrams.

TABLE VII
CROSS-TABULATION OF K-S FORMBOARD TOTAL TIME SCORES
AND THREE OR MORE FAVORABLE SHOPWORK RATINGS

K-S Total Time Scores	Shopwork Ratings			
		Less than 3+'s	Three or more +'s	Totals
		(-)	(+)	
25' or less	(+)	12	35	47
more than 25'	(-)	42	12	54
Totals		54	47	101

$$r_t = .76$$

Thus it may be seen that if the subjects had satisfactory ratings in the three significant categories they also had satisfactory ratings in all six categories in all cases but one. These correlations of .75 and .76 indicate that the use of the total time score on the K-S Formboard for the prediction of shopwork performance is a satisfactorily valid procedure.

SUMMARY

The evidence gathered by this study seems to substantiate the following conclusions:

- (1) The K-S Formboard is of value for the prediction of performance in shopwork in an adult rehabilitation program.

- (2) Total time of all eight tests is a fairly satisfactory method to indicate performance on the K-S Formboard.
- (3) A differentiating score, or critical limit, for the K-S Formboard is found to be a total time of 25 minutes or less. Time scores of 25 minutes or less serve to indicate the likelihood of favorable shopwork performance.
- (4) A score of 25 minutes or less indicates favorable shopwork performance, particularly in the following respects: accuracy, speed, and constructive thinking. A correlation coefficient (tetrachoric) of .76 was found between shop ratings in these categories and total time scores. (This last result tends to verify the statements of the authors of the test that it places a high premium upon careful planning.)
- (5) The importance of the K-S Formboard as a useful instrument in vocational guidance is indicated by this study.
- (6) Further work to check these findings in other types of training situations and to establish norms seems worthwhile.

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